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(54) A FLAP-TYPE DOCK GATE AND A DOCK HAVING SUCH A GATE

(71) We, MAUNSELL & PARTNERS PTY. LIMITED, a company incorporated under the laws of the State of Victoria, of 277 Williams Street, Melbourne, Victoria, Australia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a flap-type dock gate and to a dock having such a gate.

It is known to close a dry dock of medium to great width by using a flap-type gate which acts as a beam extending between the vertical faces at the two sides of the dock entrance. When such a known gate is in use and in the fully closed position the load of the external water pressure on the dock gate is taken up by bearing surfaces of the dock structure, which surfaces extend horizontally wholly or partly along the dock sill and also extend vertically or wholly along the dock wall at each side. In other words the load is taken up along three edge zones of the gate. Prior British Patent No. 950,756 is an example. The load is taken up by horizontally extending bearing pads of the dock sill and of the inner face of the gate along the lower edge zone of the gate, and also by vertical extending bearing pads of the dock walls and of the inner face of the gate along the side edge zones. The gate is supported by a horizontally extending hinge below the lower edge of the gate and extending across the sill.

As the size of the ships, and especially their beam, has been increased, wider docks and wider gates have become needed.

For a wide dock, for example 160 feet or more wide, the gate is very expensive because its weight increases more than in direct proportion to the increase in span.

A gate of the flap-type is usually pivoted along its lower edge and opens outwardly and downwardly in front of the dock, and a ship being docked passes over the gate. Using conventional operating procedure it is

possible to use the gate partly or wholly as a buoyancy tank, but as the gate when closed is usually above normal water level, it is necessary to provide winching equipment to lift the gate from the position in which it ceases to be buoyant, to the position in which it is fully closed. As gates have become wider and heavier so has the winching equipment become more expensive.

An object of the invention is to provide a flap-type dock gate which reduces these disadvantages.

According to this invention a flap-type dock gate is structurally of cantilever form and is so constructed that when in use in the fully closed position, the turning moment acting on the gate as a result of the external water pressure is counteracted substantially only by load-bearing surfaces of the inner and outer faces of the "lower edge zone" of the gate, which surfaces abut co-operating surfaces of the dock.

Thus the gate of the invention is in the form of a cantilever which projects from its lower edge zone and is unsupported at its upper end. By the "lower edge zone" is meant herein that part of the gate which is adjacent its lower edge. The lower edge zone comprises substantially 20% or less of the height of the gate, starting from the lower edge. The lower edge zone thus includes not only the lower edge itself, but the lower portions of the inner and outer sides of the gate and the internal structure. By "inner side" is meant herein that side of the gate which in the fully closed position of the gate faces into the dock.

The invention also includes a dock with a flap-type gate wherein the dock in or adjacent the sill has a part which is of claw-like shape in cross-section the said part having two bearing surfaces against which the lower edge zone of the gate abuts when in the fully closed position, one bearing surface engaging the inner surface of the lower edge zone and the other bearing surface engaging the outer face of the lower edge zone, the said one

bearing surface being at a higher level than the said other bearing surface.

The invention will now be described by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a cross-section of one embodiment of gate and dock;

Figure 2 is a top plan of the gate;

Figure 3 is an elevation showing the inner face of the gate looking in the direction of the arrows 3 in Figure 2;

Figure 4 is a part section on plane 4—4 of Figure 1; and

Figures 5 and 6 show two further embodiments, the views being similar to that of Figure 1.

Referring to the drawings, a flap-type dock gate 1 is 210 feet wide and approximately 36 feet high above the sill 20 of the dock. The gate structure comprises a number of main cantilever members 2, which are disposed at approximately 8 feet centres across the width of the gate. Between the main cantilever members are intermediate stiffeners 3 and 4 of "T" section, or other conventional members. As illustrated in Figure 4, the stiffeners 4 are at the outer face of the gate and the stiffeners 3 at the inner face of the gate with both sets of stiffeners being spaced at approximately 2' centres. The gate skin 5 on the outer face is made by welding sheet material to the cantilever members 2 and the stiffeners 4. At the lower edge zone of the gate, that is the part of the gate generally below the section plane 4—4 in Figure 1, the gate has two horizontally extending load bearing surfaces 6 and 7, surface 6 being at the outer face of the gate at the lower edge as shown, and surface 7 being at the inner face of the gate and at a level higher than that of the surface 6. As shown diagrammatically in Figure 1, the gate structure in the lower edge zone is reinforced behind the respective load bearing surfaces 6 and 7.

The inner bearing surface 7 is continuous and has a sealing strip 8 thereon (Fig. 3), so that when the gate is fully closed, as seen in Figure 1, the pressure of the water outside the gate and acting upon it is transferred by the bearing surface 7 onto a bearing surface 9 of a claw-section portion 10 of the dock, which portion is in or adjacent the dock sill.

In order to save weight it may be desirable to taper the lower portion of each main cantilever member 2 from the inner bearing surface 7 to the lower edge.

In order generally to locate the gate it is supported by horizontal pivots 11, which are located, in this embodiment, forwardly to the outer surface of the gate, which is a satisfactory pivotal axis for an inclined gate, as shown in Figure 1.

Pivot blocks 12 have slightly oversized holes so as to permit movement of the pivots

11 without local transfer of sideways or upwards force between pivots and pivot blocks except while the gate is being opened or closed. Further, this ensures that the part of the dock structure which is of claw-like shape in cross-section (to be described below), makes good contact with the load-bearing surfaces 6 and 7, the pivots 11 being simply for general location of the gate when it is in the fully closed position shown in Figure 1.

Fitted within the depth of the gate and part way up the height of the gate but below low water level, there may be one or more than one buoyancy tank 13. Preferably there is a single tank through which pass the main cantilever members 2, which are apertured in the tank and which act as baffles for the tank.

A second buoyancy tank 14 is provided in the lower edge zone of the gate, as shown in Figures 1 and 3. This tank is normally flooded when the gate is in use but can provide additional buoyancy during stepping and unstepping of the gate, as will be described below.

At the upper edge of the gate is a roadway or walkway 15.

On each side of the gate, at its inner face, are rubber quoin seals 16 (Fig. 4) which, when the gate is fully closed, abut the sides of the dock so that the quoin seals 16 and the sealing strip 8 together seal the dock.

Referring to Figure 1, the dock has adjacent the sill 20, a part which extends across the dock floor and which as shown is of claw-like shape in cross-section. This may be referred to as the "claw part". This claw part has two bearing surfaces 9 and 21 against which the lower edge zone of the gate abuts. The bearing surface 9 engages the inner face load bearing surface 7 and the bearing surface 21 engages the outer load bearing surface 6. The pivot blocks 12 are located just forwardly of the claw part and are fixed to the concrete of the harbour floor. A trash flap 22 protects the seal between the claw part and the gate inner face. Because of the outward lean of the gate when fully closed, it is not necessary that a trash flap be provided on the outer face as the pivots and outer bearing surfaces are protected by this lean, and when the gate is open, again, the outer bearing surfaces are protected.

Thus the arrangement above-described provides a flap-type dock gate which is structurally of cantilever form. When in the fully closed position shown in Figure 1 the water pressure acting on the outer face 5 results in a turning moment which acts on the gate about its lower edge zone. The side edges of the gate and its upper edge are substantially non-load bearing, although they may bear a very small proportion of the load, for example sufficient to compress the quoin seals.

Thus the turning moment is counteracted substantially only by the claw part bearing surfaces 9 and 21 along the lower edge zone of the gate at the respective bearing surfaces 7 and 6. The latter surfaces constitute, as may be understood from Figure 1, respective substantially vertical, horizontally extending portions of the inner and outer faces of the lower edge zone of the gate, and the surface 7 is at a higher level than the surface 6. The turning moment is counteracted in that the external water pressure acting on the up-standing cantilever gate causes the inner face of the gate to press against the bearing surface 9 of the claw part, and this surface acts as it were as a pivot axis in that the gate tends to turn about that axis. This turning tendency is resisted by the bearing surface 21 of the claw part against which the outer face of the gate presses. In this manner the gate is held fixed in the fully closed position, the pivots 11 serving substantially only to transmit downward loading.

If required the surface 6 may have a seal, and an auxiliary quoin seal 23 can be provided on the outer face of the gate so that when the gate is closed the claw part can be dewatered and access thereto can be obtained through an access shaft 24 (Fig. 2). The seals on the surface 6 and the auxiliary quoin seal 23 are normally only provided when the claw part is to be dewatered and are placed in position specifically for that operation.

When the gate is open it is located on the harbour floor outwardly of the dock entrance, as indicated in dot-dash lines in Figure 1, and in order to control opening of the gate it is advantageous to provide a gate well 25 extending outwardly from the dock entrance, which well acts as a dash pot when the gate is opening; the movement of water around the gate and over a wall 26 of the well 25 slows opening of the gate to reduce impact. Located in the gate well 25 is a shock absorber 27 against which the gate abuts when fully opened.

To step the gate the buoyancy tanks 13 and 14 are aerated and it is floated to a position where it is beyond the dock with that edge of the gate which is to be the lower edge, pointing inwardly towards the dock. When the gate is in this position the buoyancy tanks are partly filled with water and the amount is adjusted until the pivots 11 can be located on the pivot blocks 12, and, when located, keepers are attached over the tops of the pivot blocks. When the gate has been stepped the auxiliary buoyancy tank 14 can be filled with water.

To keep the gate closed mechanical latches are provided between the gate and the dock wall.

In use, when a ship is to be docked and the dock is full of water, it is only neces-

sary to release the latches and fill the buoyancy tanks 13 with water. As this fills there is an opening moment about the pivot axis and the gate opens, being controlled by the rate of air exhaust. When the gate is fully open the main cantilever members 2 abut the shock absorber 27. The roadway 15 is protected from damage by the wall 26.

The ship is then moved into the dock and then the buoyancy tank 13 is aerated and the gate will ascend to its fully closed position, where the latches are applied. The dock is then dewatered and, as the water level drops, the external pressure of water on the gate causes a seal to be formed at the bearing points. As the dock is dewatered the pressure acting on the skin plate increases and retains the gate in position. To open the gate it is only necessary to fill the dock with water, open the latches, and displace air from the buoyancy tank 13, when the gate will open.

As the external water pressure is divided between the main cantilever members, a gate of any width can be designed and such gate should operate satisfactorily.

In the embodiment above described the gate is tilted outwardly when fully closed since in this way, the gate can have readily accessible pivots, and a claw part which is readily accessible when the gate is open. At the same time access to the claw part can be gained when the gate is closed by means of the access shaft 24.

In Figure 5 another embodiment is shown which, when fully closed, is vertical. In this gate the pivot 30 is within the lower edge zone. The operating buoyancy tank 31 provides a turning moment for opening and closing. This form of gate is satisfactory in operation but it is difficult to gain access for maintenance of the pivot.

The embodiment of Figure 6 is similar to that of Figure 5 but the operating buoyancy tank 32 is external to the gate, providing a greater closing moment. This embodiment of gate is heavier than the other embodiments and is slightly more difficult to step and unstep.

In each embodiment described above the skin plate is on the outer face and is in tension when the gate is closed and the dock dewatered. Such an arrangement provides for safety. Should the gate be struck by a ship there would tend to be only local damage, whereas with a conventional gate there can be a compression instability across the full width of the gate. It is, however, possible to provide the gate of the invention with a skin plate on the inner gate face, either or without the outer skin face plate; in some applications this may be desirable.

The gate could be made as a single cantilever structure in which case it would have both inner and outer skins so that when the

dock is dewatered the outer skin is in tension and the inner skin is in compression.

Although the use of buoyancy tanks is referred to above, the invention is equally applicable to a gate opened and closed by mechanical means and also to a gate which uses a combination of mechanical means and buoyancy.

Also there has been described above a gate having a single buoyancy tank 13 but in some applications it may be desirable to provide a number of buoyancy tanks, some of which act as air tanks and others which can be selectively aerated or flooded to assist in the control of opening and closing.

WHAT WE CLAIM IS:—

1. A flap-type dock gate which in structurally of cantilever form and is so constructed that when in use in the fully closed position, the turning moment acting on the gate as a result of the external water pressure is counteracted substantially only by load bearing surfaces of the inner and outer faces of the "lower edge zone" of the gate, which surfaces abut co-operating surfaces of the dock.

2. A flap-type dock gate which is structurally of cantilever form and which has a "lower edge zone" which is so constructed that when in use in the fully closed position, the turning moment acting on the gate as a result of the external water pressure is counteracted substantially only by a respective horizontally extending load bearing surface of the inner and outer faces of the "lower edge zone" abutting co-operating surfaces on the dock sill, the load bearing surface of the inner face being at a higher level than the load bearing surface of the outer face.

3. A gate according to claim 1 or claim 2 which comprises a plurality of cantilever members, the gate having a skin on at least one face thereof.

4. A gate according to claim 3, wherein the skin is on the outer face of the gate.

5. A gate according to claim 3 which is a single cantilever, and has outer and inner skins, the outer skin being in tension and the inner skin being in compression when the dock is dewatered.

6. A gate according to any preceding claim having a buoyancy tank spaced above the lower edge zone, the tank being such that it can provide a gate-opening or gate-closing turning moment about a pivot adjacent the lower edge of the gate.

7. A gate according to claim 6, wherein the tank is within the gate.

8. A gate according to claim 6, wherein the tank is on an external surface of the gate. 60

9. A gate according to any of claims 6 to 8 having a further buoyancy tank located adjacent the lower edge of the gate.

10. A dock with a flap-type gate according to any preceding claim, wherein the dock in or adjacent the sill has a part which is of claw-like shape in cross-section the said part having two bearing surfaces against which the lower edge zone of the gate abuts when in the fully closed position, one bearing surface engaging the inner face of the lower edge zone and the other bearing surface engaging the outer face of the lower edge zone, the said one bearing surface being at a higher level than the said other bearing surface. 65 70 75

11. A dock according to claim 10, wherein a sealing member extends along that bearing surface which engages the inner face.

12. A dock according to claim 10 or claim 11, wherein mechanical means are provided for raising and lowering the gate. 80

13. A dock according to any of claims 10 to 12, wherein the gate has pivots associated with pivot blocks on the dock adjacent the said part, the pivot blocks being formed so as to permit movement of the pivots without local transfer of sideways or upwards force between pivots and pivot blocks except whilst the gate is being opened or closed. 85 90

14. A dry dock constructed and arranged substantially as herein described and shown in Figures 1 to 4 or Figure 5 or Figure 6 of the accompanying drawings.

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Although the use of buoyancy tanks is referred to above, the invention is equally applicable to a gate opened and closed by mechanical means and also to a gate which uses a combination of mechanical means and buoyancy.

Also there has been described above a gate having a single buoyancy tank 13 but in some applications it may be desirable to provide a number of buoyancy tanks, some of which act as air tanks and others which can be selectively aerated or flooded to assist in the control of opening and closing.

WHAT WE CLAIM IS:—

1. A flap-type dock gate which is structurally of cantilever form and is so constructed that when in use in the fully closed position, the turning moment acting on the gate as a result of the external water pressure is counteracted substantially only by load bearing surfaces of the inner and outer faces of the "lower edge zone" of the gate, which surfaces abut co-operating surfaces of the dock.

2. A flap-type dock gate which is structurally of cantilever form and which has a "lower edge zone" which is so constructed that when in use in the fully closed position, the turning moment acting on the gate as a result of the external water pressure is counteracted substantially only by a respective horizontally extending load bearing surface of the inner and outer faces of the "lower edge zone" abutting co-operating surfaces on the dock sill, the load bearing surface of the inner face being at a higher level than the load bearing surface of the outer face.

3. A gate according to claim 1 or claim 2 which comprises a plurality of cantilever members, the gate having a skin on at least one face thereof.

4. A gate according to claim 3, wherein the skin is on the outer face of the gate.

5. A gate according to claim 3 which is a single cantilever, and has outer and inner skins, the outer skin being in tension and the inner skin being in compression when the dock is dewatered.

6. A gate according to any preceding claim having a buoyancy tank spaced above the lower edge zone, the tank being such that it can provide a gate-opening or gate-closing turning moment about a pivot adjacent the lower edge of the gate.

7. A gate according to claim 6, wherein the tank is within the gate.

8. A gate according to claim 6, wherein the tank is on an external surface of the gate.

9. A gate according to any of claims 6 to 8 having a further buoyancy tank located adjacent the lower edge of the gate.

10. A dock with a flap-type gate according to any preceding claim, wherein the dock in or adjacent the sill has a part which is of claw-like shape in cross-section the said part having two bearing surfaces against which the lower edge zone of the gate abuts when in the fully closed position, one bearing surface engaging the inner face of the lower edge zone and the other bearing surface engaging the outer face of the lower edge zone, the said one bearing surface being at a higher level than the said other bearing surface.

11. A dock according to claim 10, wherein a sealing member extends along that bearing surface which engages the inner face.

12. A dock according to claim 10 or claim 11, wherein mechanical means are provided for raising and lowering the gate.

13. A dock according to any of claims 10 to 12, wherein the gate has pivots associated with pivot blocks on the dock adjacent the said part, the pivot blocks being formed so as to permit movement of the pivots without local transfer of sideways or upwards force between pivots and pivot blocks except whilst the gate is being opened or closed.

14. A dry dock constructed and arranged substantially as herein described and shown in Figures 1 to 4 or Figure 5 or Figure 6 of the accompanying drawings.

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